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National Eutrophication Survey, Las Vegas, Nev

Prepared for

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Feb 77

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

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ON
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REYNOLDS AND WAYNE COUNTIES
MISSOURI

EPA REGION VII

WORKING PAPER NO. 347

WITH THE COOPERATION OF THE

MISSOURI DEPARTMENT OF NATURAL RESOURCES

AND THE

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT ON CLEARWATER LAKE

REYNOLDS AND WAYNE COUNTIES, MISSOURI

EPA REGION VII

by

National Eutrophication Survey

Water and Land Monitoring Branch
Monitoring Applications Laboratory
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Eutrophication Survey Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Missouri Department of Natural Resources for professional involvement, to the Missouri National Guard for conducting the tributary sampling phase of the Survey, and to those Missouri wastewater treatment plant operators who provided effluent samples and flow data.

The staff of the Missouri Department of Natural Resources, James Wilson, Director; the Division of Environmental Quality, Ken Karch, Director; and the Water Quality Program, James Odendahl, Director, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

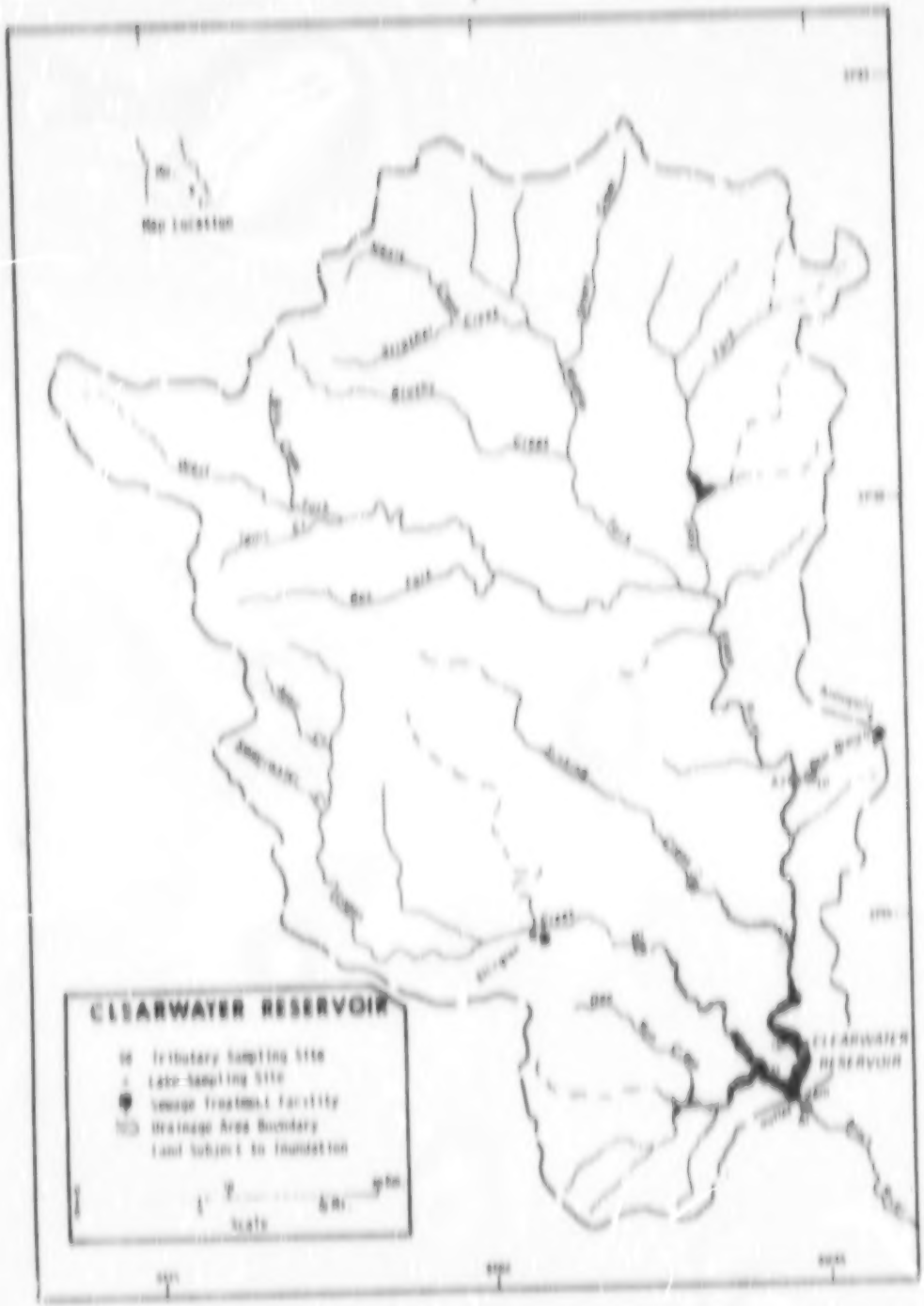
Major General Charles M. Kiefner, the Adjutant General of Missouri, and Project Officer Captain Donald L. Wellen, who directed the volunteer efforts of the Missouri National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MISSOURI

LAKE NAME	COUNTY
Clearwater Lake	Reynolds
Pomme de Terre Reservoir	Polk, Hickory
Stockton Reservoir	Dade, Polk, Cedar
Lake Taneycomo	Taney
Thomas Hill Reservoir	Macon, Randolph
Lake Wappapello	Wayne, Butler


CLEARWATER RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
Land Subject to Inundation
Scale
CLEARWATER RESERVOIR

REPORT ON CLEARWATER LAKE, MISSOURI
STORET NO. 2901

I. CONCLUSIONS

A. Trophic Condition:*

Based upon field observations and Survey data, Clearwater Lake is considered mesotrophic. Chlorophyll a values ranged from a low of 0.3 µg/l in the spring to a high of 6.6 µg/l in the fall with a mean of 3.6 µg/l. Secchi disc visibility was high during the summer sampling period, but low during spring and autumn. Of the six Missouri lakes sampled in 1974, five had higher total phosphorus values, four had higher inorganic nitrogen levels and four had higher orthophosphorus values than Clearwater Lake.

Survey limnologists reported an algal bloom during October sampling of the lake.

B. Rate-Limiting Nutrient:

Algal assay results indicate that Clearwater Lake was limited by available phosphorus levels. Spikes with phosphorus or nitrogen and phosphorus simultaneously resulted in increased assay yields. Addition of nitrogen alone did not stimulate a growth response. The ratios of available nitrogen to orthophosphorus (N/P) in sampled waters further substantiate phosphorus limitation.

*See Appendix E.

C. Nutrient Controllability:

1. Point sources -

Point sources contributed 16.5% of the total phosphorus load to Clearwater Reservoir during the sampling year. The city of Ellington contributed 11.5% of the total phosphorus load, and the city of Annapolis was estimated to contribute 5.0%.

The calculated annual phosphorus loading for Clearwater Reservoir of 1.16 g $P/m^2/yr$ is less than Vollenweider's (1975) eutrophic loading for a lake with such volume and retention time. However, loading calculations based upon available nutrient concentrations and flow data yield a net export of both phosphorus and nitrogen from the reservoir, indicating sampling was not adequate to depict actual loading and export rates. This export could be attributable to unmeasured point sources in the Clearwater watershed. The Missouri Department of Natural Resources (manuscript) lists six industrial and mining point sources which are significant sources of pollution, particularly heavy metal and thermal, to Clearwater Reservoir. Additional sampling is needed to determine the impact of these sources on the nutrient budget of the reservoir before recommendations for maintaining the high water quality in this lake can be made.

V. Nonpoint sources -

The total phosphorus load from nonpoint sources (including precipitation) accounted for 83.5% of the loading reaching the lake. The Black River contributed 41.1% of the phosphorus load, and ungaged tributaries were estimated to have contributed 10.6%.

The annual phosphorus exports of the tributaries to Clearwater Lake are comparable to the export of Clark Creek, an unimpacted tributary of nearby Lake Wappapello* (3 kg P/km^2/yr).

*NES Working Paper No. 551

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake morphometry data were provided by the Missouri Clean Water Commission. Tributary flow data were provided by the Missouri District Office of the U.S. Geological Survey (USGS). Outlet drainage area includes the lake surface area. Mean hydraulic retention time was obtained by dividing the lake volume by the mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 6.60 km^2.
2. Mean depth: 4.1 meters.
3. Maximum depth: 14.6 meters.
4. Volume: 27,060 x 10^6 m^3.
5. Mean hydraulic retention time: 13 days.

B. Tributary and Outlet:
(See Appendix B for flow data)

1. Tributaries -

Name	Drainage area(km²)	Mean flow (m³/sec)
A-2 Black River	1,676.9	15.75
B-1 Logan Creek	445.5	3.23
C-1 Sinking Creek	191.7	1.25
Minor tributaries and immediate drainage -	405.2	4.33
Totals	2,319.3	24.06
2. Outlet - A-1 Black River	2,325.0	24.00

C. Precipitation:

1. Year of sampling: 110.0 cm.
2. Mean annual: 107.5 cm.

III. LAKE WATER QUALITY SUMMARY

Clearwater Lake was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll *a* analysis and phytoplankton identification and enumeration. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 11.9 meters at Station 01, 4.3 meters at Station 02, and 6.4 meters at Station 03. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll *a* determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

[illegible]

[illegible] AND CHEMICAL CHARACTERISTICS

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/09/74	1. Chroomonas	266
	2. Nitzschia	222
	3. Cryptomonas	177
	4. Melosira	177
	5. Cyclotella	133
	Other genera	45
	Total	1,020
06/10/74	1. Chroomonas	428
	2. Synedra	238
	3. Cryptomonas	190
	4. Centric Diatom	95
	5. Ankistrodesmus	48
	Other genera	190
	Total	1,189
10/08/74	1. Cryptomonas	166
	2. Melosira	166
	3. Coccoid cell	66
	4. Peridinium	66
	5. Trachelomonas	66
	Other genera	[illegible]
	Total	496

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/09/74	01	4.5
	02	0.3
	03	6.1
06/18/74	01	3.3
	02	1.0
	03	2.6
10/08/74	01	6.6
	02	2.2
	03	5.5

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked - 04/09/74

Spike(mg/l)	Ortho P Conc.(mg/l)	Inorganic N Conc.(mg/l)	Maximum Yield (mg/l-dry wt.)
Control	<0.005	0.154	0.1
0.05 P	<0.055	0.154	3.7
0.05 P + 1.0 N	<0.055	1.154	15.3
1.00 N	<0.005	1.154	0.1

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential for primary production in Clearwater Lake was low during the spring. Increased growth of the test alga in response to an addition of orthophosphorus indicates the lake was limited by available phosphorus. Spikes with nitrogen alone did not stimulate a growth response.

The fall algal assay results are not considered reliable because of a significant change in the nutrient levels between the time the sample was collected and the assay begun.

The N/P ratios in sampled waters were 56/1 in the spring, 31/1 in the summer, and 40/1 in the fall, further suggesting primary limitation by phosphorus (a mean N/P of 14/1 or greater generally reflects phosphorus limitation).

IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the Missouri National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of May when two samples were collected. Sampling was begun in September 1974, and was completed in August 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Missouri District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual nutrient loads, in $kg/km^2/yr$, in Sinking Creek at Station C-1, and multiplying the means by the ZZ area in km^2.

The operator of the Ellington wastewater treatment plant provided monthly effluent samples and corresponding flow data. Nutrient loads for the city of Annapolis wastewater treatment plant were estimated at 1.134 kg P and 3.401 kg N/capita/yr.

A. Waste Sources:

1. Known municipal -

Name	Population Served	Treatment	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Ellington	1,100	Stabilization pond	0.093	Logan Creek
Annapolis*	335	Stabilization pond	0.127**	Black River

2. Known industrial - see discussion, page 2.

*U.S. EPA, 1971.
**Estimated at 0.3785 m^3/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source		kg P/yr	% of total
a.	Tributaries (nonpoint load) -		
	A-2 Black River	4,080	61.1
	B-1 Logan Creek	410	5.3
	C-1 Sinking Creek	305	4.0
b.	Minor tributaries and immediate drainage (nonpoint load) -	810	10.6
c.	Known municipal STP's -		
	Ellington	885	11.5
	Annapolis	380	5.0
d.	Septic tanks* -	15	0.2
e.	Known industrial - see discussion, page 2.		
f.	Direct precipitation** -	115	1.9
	Totals	7,660	100.0
2.	Output - A-1 Black River	20,965	
3.	Net annual P export*** -	13,305	

*Estimate based on 13 lakeside residences and 6 camps.
**Estimated (see NES Working Paper No. 175).
***Export probably due to unknown sources and/or sampling error.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
A-2 Black River	489,665	62.3
B-1 Logan Creek	147,960	18.8
C-1 Sinking Creek	44,070	5.6
b. Minor tributaries and immediate drainage (nonpoint load) -	93,195	11.8
c. Known municipal STP's -		
Ellington	2,420	0.3
Annapolis	1,140	0.2
d. Septic tanks* -	960	0.1
e. Known industrial - see discussion, page 2.		
f. Direct precipitation** -	7,125	0.9
Totals	786,135	100.0
2. Output - A-1 Black River	973,230	
3. Net annual N export*** -	187,095	

*Estimate based on 13 lakeside residences and 6 camps.
**Estimated (see NES Working Paper No. 175).
***Export probably due to unknown sources and/or sampling error.

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Black River	4	303
Logan Creek	1	332
Sinking Creek	2	230

E. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P (mg/l)	Mean Total N (mg/l)
D-1 Bear Branch	0.018	1.362

Nutrient levels for the above tributary are higher than those found for the gaged tributaries to Clearwater Lake.

f. Yearly Loadings:

In the following table, the existing phosphorus annual loading is compared to the relationship proposed by Vollenweider (1975). Essentially, his eutrophic loading is that at which the receiving waters would become eutrophic or remain eutrophic; his oligotrophic loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between eutrophic and oligotrophic.

Note that Vollenweider's model may not apply to lakes with short hydraulic retention times or in which light penetration is severely restricted by high concentrations of suspended solids in the surface waters.

	Total Yearly Phosphorus Loading ($g/m^2/yr$)
Estimated loading for Clearwater Lake	1.16
Vollenweider's eutrophic loading	2.02
Vollenweider's oligotrophic loading	1.01

V. LITERATURE REVIEWED

Missouri Department of Natural Resources (manuscript). Water Quality Management Basin Plan for the White River Basin. Division of Environmental Quality, Jefferson City, Missouri.

U.S. Environmental Protection Agency. 1971. Inventory of Municipal Waste Facilities. EPA Publication #OWP-1, Vol. 7. Office of Media Programs, Office of Water Programs, U.S. Gov't. Printing Office, Washington, D.C.

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. National Environmental Research Center, Las Vegas, Nevada, and Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.

Vollenweider, R. A. 1975. Input-Output Models With Special Reference to the Phosphorus Loading Concept in Limnology. Schweiz. Z. Hydrol. 37:53-84.

VI. APPENDICES

APPENDIX A
CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107 x 10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX B

TRIBUTARY FLOW DATA

[illegible] CODE 2901 [illegible]

TOTAL DRAINAGE AREA OF LAKE(S) = 2325.4

[illegible]	SUB-DRAINAGE AREA(S)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
							[illegible] FLOW(CFS)						
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
29004	2325.4	23.61	33.49	39.39	38.23	36.41	25.54	15.12	14.19	12.22	11.47	14.49	20.48
29004	1295.4	36.25	35.14	34.42	29.73	28.25	19.11	8.24	4.78	5.58	7.11	11.33	12.15
29003	4.5	2.49	3.77	5.14	5.05	4.63	4.15	2.92	1.11	1.67	1.79	1.74	1.53
29001	191.7	8.69	1.44	2.21	2.27	2.46	1.17	1.25	0.48	0.66	0.71	0.54	0.54
29002	401.4	4.38	5.41	7.48	6.33	5.42	4.76	2.72	1.38	1.73	2.19	2.44	3.11

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 2325.4
SUM OF SUB-DRAINAGE AREAS = 2325.4

[illegible] FLOW IN = 295.45
[illegible] FLOW OUT = 296.38

[illegible] MONTHLY FLOWS AND DAILY FLOWS(CMS)

[illegible]	[illegible]	[illegible]	[illegible] FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
29004	9	74	24,381	14	19,468				
	10	74	15,493	5	18,349				
	11	74	23,163	2	13,451				
	12	74	22,172	7	28,883				
	1	75	42,758	10	71,142				
	2	75	42,435	1	74,617				
	3	75	74,198	11	48,547				
	4	75	48,545	5	74,467				
	5	75	54,885	3	48,946	17	64,846		
	6	75	18,293	28	12,179				
	7	75	12,573	27	13,251				
	8	75	11,865	28	6,635				
29004	9	74	11,385	14	19,884				
	10	74	6,987	5	6,654				
	11	74	21,521	2	9,098				
	12	74	7,788	8	8,419				
	1	75	36,529	10	17,367				
	2	75	51,253	1	1,139				
	3	75	47,572	11	31,888				
	4	75	38,582	5	21,439				
	5	75	19,742	3	24,647	17	14,357		
	6	75	8,513	28	5,663				
	7	75	5,868	27	5,728				
	8	75	6,109	28	5,598				

APPENDIX C

PHYSICAL AND CHEMICAL DATA

APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

[illegible]

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	OF		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TO	DAY	FEET	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	13	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	13	00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* VALUE [illegible] TO BE
LESS THAN INDICATED

[illegible]

[illegible]
37 07 SC.JI 098 46 28.0 4
BLACK [illegible]
24 T.D CLAIMED? JAM
[illegible] 000541
JAM SPILLWAY 56 FT SW OF [illegible]
132[illegible] 0480109
0000 FEET 30[illegible] CLASS 00

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[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	DAY	FEET	[illegible]	[illegible]	TOTAL	[illegible]	[illegible]
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[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]
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[illegible]
37 [illegible] 38.8 088 45 58.8 W
BLACK RIVER
29 [illegible] LESTER PRAIRIE SE
TYDELEPHONE RESERVOIR 108542
[illegible] OF [illegible] OF MINNEAPOLIS
[illegible] 0480286
8000 FEET DEPTH CLASS 56

-43-

[illegible]

[illegible]

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	OF	W/TOTAL	[illegible]	%	TOTAL	[illegible]	
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L	MG/L
[illegible]	12	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	80	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* [illegible]
LESS THAN INDICATED

[illegible]

[illegible]

[illegible]

STORET RETRIEVAL DATE [illegible]*

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	OF	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
TO	DAY	FEET	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* [illegible]
[illegible]

[illegible]

[illegible]

[illegible]

DATE FROM TO	TIME OF DAY	DEPTH FEET	[illegible] RESIDUE TOTAL MG/L	[illegible] TOT KJEL N MG/L	[illegible] NITRATE TOTAL MG/L	[illegible] PHOS-ORTH (MG/L P)	[illegible] PHOS-TOT (MG/L P)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] VALUE KNOWN TO BE LESS THAN INDICATED

[illegible]

[illegible] RETRIEVAL DATE 75/03/24

[illegible]

[illegible]
[illegible]
[illegible]

APPENDIX E

PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1974

STATE OF MISSOURI

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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

LAND USE	LAND NAME	[illegible] TOTAL #	[illegible] INCOME $	[illegible] AVG. VET	[illegible] CAPITAL	[illegible] AVG. IN	[illegible] EDUC. DEGREE %
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]